FeO MAPPING OF THE MOON: REFINEMENT USING IMAGES OF THE SAMPLE-RETURN STATIONS. D. T. Blewett[1], P. G. Lucey[1], B. R. Hawke[1], and B. L. Jolliff[2]. [1]Planetary Geosciences, HIGP, Univ. of Hawaii, 2525 Correa Rd., Honolulu, HI 96822, dave@kahana.pgd.hawaii.edu. [2]Dept. Earth & Planetary Sci., Washington Univ., Box 1169, St. Louis, MO 63130, blj@levee.wustl.edu.

Introduction. The Apollo 15, 16 and 17 astronaut traverses were sufficiently long that individual sampling stations can be resolved in images returned by the Clementine I spacecraft. This allows us to refine the technique for multispectral iron determination [1, 2] by increasing the number of ground-truth calibration points. The technique was developed using global low-resolution (~35 km/pixel) Clementine UVVIS camera image products, and has also been applied to Galileo SSI images of the Moon. Our goal is to develop a calibration for the full-resolution UVVIS images using images of the sample-return sites.

The images used here were processed in the Integrated Software for Imaging Spectrometers (ISIS) system developed by the U.S. Geological Survey, using standard routines designed for Clementine UVVIS data. The processing scheme, similar to that described by [3], includes gain and offset correction, exposure time normalization, dark current and readout time correction, pixel sensitivity non-uniformity (flat-field) correction, long and short exposure merger, registration of the A (415 nm), C (900 nm), D (950 nm) and E (1000 nm) filter images to the B (750 nm), photometric correction ([4] and more recent updates), geometric control using information stored in the image SPICE labels, conversion to orthographic projection at 125 m/pixel spatial resolution, and mosaicking of the resulting 5-band cubelets. Finally, the images were converted to "absolute" reflectance by dividing by the spectrum of the Apollo 16 telescopic site extracted from the Clementine images, then multiplying by the laboratory spectrum of Apollo 16 soil 62231.

For Apollo 11-14, and Luna 16-24, landing sites were located in the image cubes by a combination of pixel latitude/longitude coordinates provided by the ISIS image display program QVIEW, landing site maps, orbital photography, NASA Preliminary Science Reports, and other published reports. For these sites, an area typically 11 x 11 pixels centered on the landing site was averaged to produce the 5-point reflectance spectrum. At Apollo 15, 16, and 17, landmarks make the sites readily identifiable. Traverse maps were used to locate the sampling stations. For most stations, 3 x 3 pixel boxes were averaged. In a few cases slightly larger areas were used where two stations are located close together. The data set consists of eight stations at Apollo 15, seven at Apollo 16, and nineteen (including rover stations) at Apollo 17.

Soil composition data for <1mm fines was compiled from previous literature, chiefly [5] and sources therein. For Apollo 11-14 and the Luna sites, representative averages of soils were used for the site value. Individual sampling station values were used for Apollo 15-17.

FeO Analysis: For each site or station, the 950/750 nm reflectance ratio was plotted against the 750 nm reflectance (Fig. 1). The points define trends based on the maturity and FeO content of the surface material at each location. Soils with higher FeO plot toward the lower left, a result of two strong absorptions produced by Fe^{2+} in minerals and glasses. A broad absorption in the ultraviolet and visible reduces the reflectance near 750 nm, and a narrower feature near 1000 nm produces a low 950/750 ratio. Maturity (extent of exposure to particle and radiation fluxes in the space environment) increases to the upper left, as the accumulation of submicroscopic metallic Fe causes lunar material to darken and redden (increase 950/750 nm ratio). Soils with the same FeO content but differing maturity thus plot along lines pointing to a common origin at the location of a hypothetical highly mature endmember, and the spectral angle Fe-parameter θ measured from that origin is highly correlated with the FeO content of the soil. In the present case, the highest correlation (0.972) of θ with station FeO was found for an origin at (750 nm reflectance = 0.07, 950/750 ratio = 1.18). Thus θ = -atan{[(950/750)-1.18]/[R750-0.07]}. A graph showing the measured FeO of returned soils vs. θ appears in Fig. 2. Fitting a line to the data of Fig. 2 gives wt.% FeO = (17.753 x θ) - 2.010.

The excellent, linear fit of the spectral Fe-parameter to the compositional data for the 40 sites and stations enhances confidence in the method, and indicates that Fe-mapping can be reliably extended to unsampled areas of the Moon.

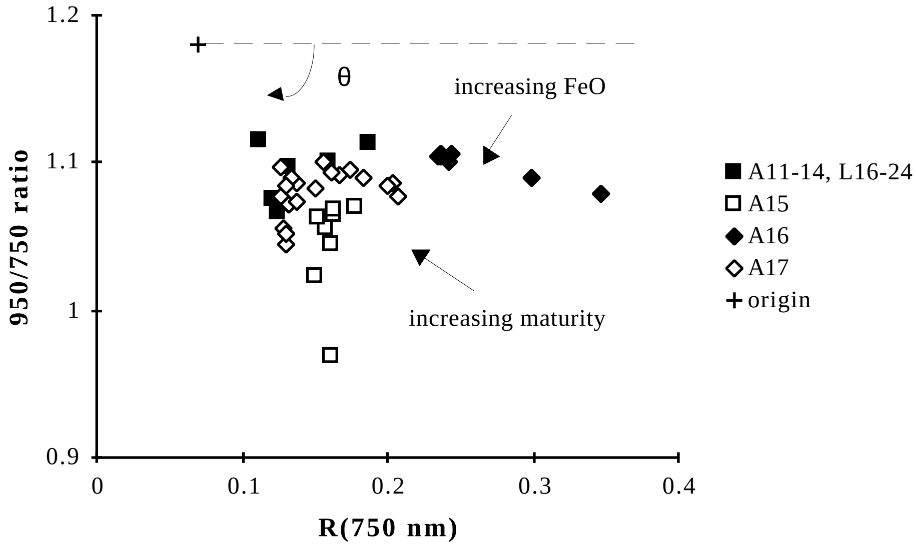

Figure 1. Near-IR ratio-reflectance plot for lunar sample-return sites and stations.

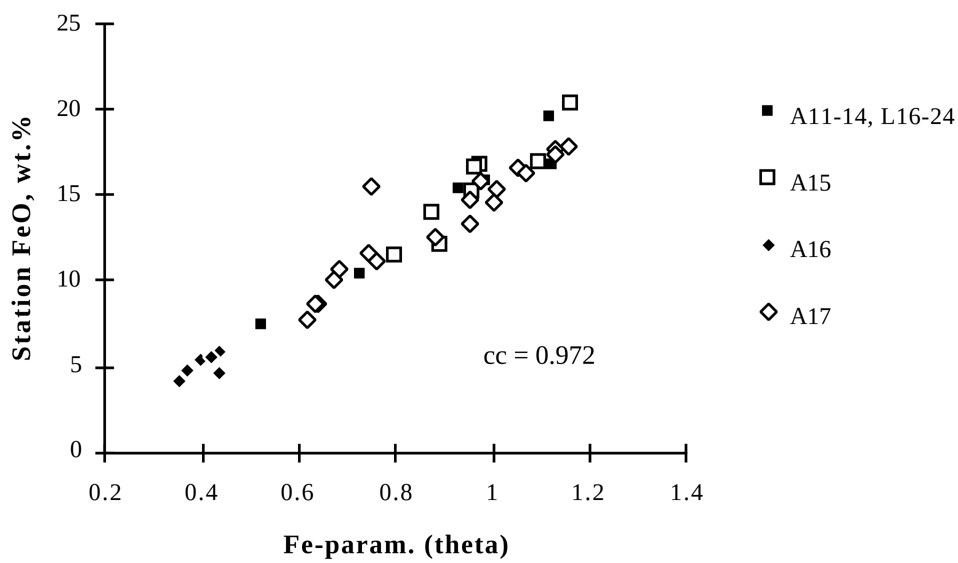

Figure 2. Plot of sample-return site or station soil FeO content vs. Clementine Fe-parameter (q).

References: [1] Lucey *et al.* (1995) *Science* **268**, 1150. [2] Lucey *et al.* (1997) *J. Geophys Res.*, submitted. [3] Pieters *et al.* (1994) *Science* **266**, 1844. [4] McEwen (1996) *Lunar Planet. Sci. XXVII*, 841. [5] Korotev (1981) *Proc. LSC 12th*, 577; Korotev (1987) *Proc. LPSC 17th*, E411; Korotev and Kremser (1992) *Proc. LPS 22nd*, 275.